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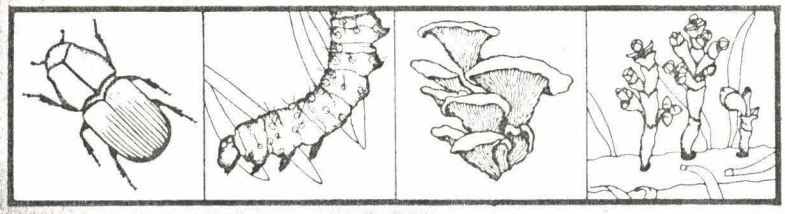

Report No.
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January 1982

STATUS OF MOUNTAIN PINE BEETLE INFESTATIONS FLATHEAD NATIONAL FOREST AND OTHER PORTIONS OF MONTANA 1981

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by

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ABSTRACT

Current mountain pine beetle populations began expanding in Montana in 1969. Infestations were detected on the Kootenai National Forest and in Glacier National Park in 1972; Lolo National Forest in 1973; and Flathead National Forest in 1974. Infestations now encompass more than 143,175 acres on the Kootenai National Forest; 192,440 acres in Glacier National Park; 27,365 acres on the Plains Ranger District, Thompson River State Forest, and adjacent private lands, Lolo National Forest; and 197,477 acres on the Flathead National Forest.

Infestations are predicted to increase on the Kootenai and Lolo National Forests, on the Hungry Horse, Swan, and Tally Lake Ranger Districts, Flathead National Forest; and on the eastern and southern portions of Glacier National Park. However, a continued decline in tree mortality is predicted for the Glacier View Ranger District, Flathead National Forest, and the west side of Glacier National Park primarily due to host depletion.

INTRODUCTION

The Northern Region is presently undergoing the most devastating period of mountain pine beetle infestations in recorded history. The beetle, like fire, has been active and has coexisted in the ecosystem as long as there has been lodgepole pine. The large increase in ground fuel and associated increase in the probability of large, high intensity fires due to beetle epidemics suggests that the relationship between beetle infestations, fire, and lodgepole pine tends to perpetuate the problem. Due to man's fire management during the past 50 to 70 years, extensive stands of evenaged lodgepole pine were allowed to mature and become susceptible, which contributed to the extensive, destructive infestations we are now experiencing.

United States Department of Agriculture | Forest Service | Northern Region | State & Private Forestry | P.O. Box 7669 Missoula, Montana 59807

The current infestations began and developed to epidemic proportions in high hazard lodgepole pine stands on the Gallatin National Forest in 1969; Beaverhead and Kootenai National Forests in 1972; Lolo National Forests in 1973; (Flathead National Forest in 1974) and in Glacier National Park in 1972. Beetle populations have continued to increase yearly. Epidemic infestations now extend over 2.6 million acres of Federal, State, and private forested lands. Although the majority of infestation occurs in high hazard lodgepole pine stands (those with lodgepole pine more than 80 years old and which average 8 inches d.b.h. and greater), beetle populations are also infesting adjacent moderate and low hazard stands. Extensive mortality has occurred in high elevation whitebark pine stands, with minor increasing mortality in stands of western white and ponderosa pines. Occasional mortality of Engelmann spruce has occured in Glacier National Park and in the Gallatin National Forest due to high beetle populations.

Infestations have persisted for nearly a decade in some areas. Barring the occurrence of conditions unfavorable to the beetle, such as extreme winter temperatures, epidemics generally persist for an average of 8 to 9 years until the large diameter pine component of the stand is severely depleted. Thus most of the current outbreaks are not likely to subside for several years, particularly in drainages containing an ample supply of mature susceptible trees. The duration of some infestations, particularly in the North Fork drainage and in Glacier National Park persisted for a shorter period of time due to the tremendous beetle population generated from large diameter trees. As the large diameter lodgepole pine was killed in these highly susceptible stands, beetles migrated to adjacent high hazard stands, and also infested and killed many lodgepole pines in moderate and low hazard stands. The possibility of a decline of the current outbreaks due to severe winter temperatures is possible in some drainages. However, if susceptible stands exist, beetle populations can rebound rapidly.

Surveys through 1981 estimate about 70 million lodgepole pine containing 3.9 billion board feet have been killed in the Northern Region since 1969. This is a conservative estimate because many infested areas containing thousands of dead trees have been logged since 1973.

CURRENT STATUS

In northwestern Montana, acres infested have progressively increased since 1972. The chronological development of the Flathead National Forest epidemic is shown in Figure 1.

For comparative purposes, infested acres mapped during aerial detection surveys are shown in table 1-4. Estimates of trees killed/acre during 1979, 1980, and 1981, and the predicted trend for 1982 are shown in table 5.

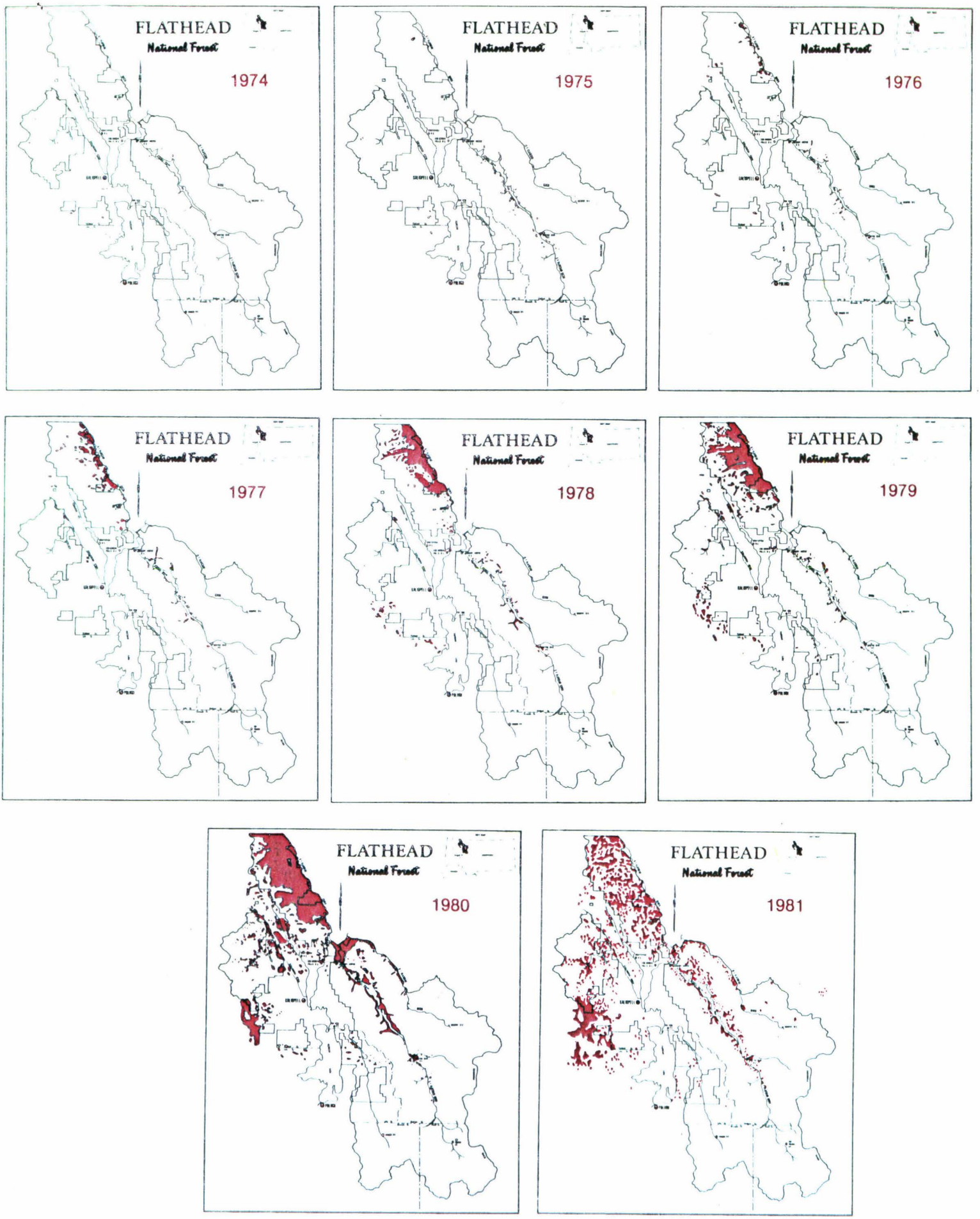

Figure 1.--Chronology of mountain pine beetle infestations, Flathead National Forest and adjoining State and private lands, Montana, 1974-1981.

Table 1.--Acres infested by host type, Flathead National Forest, 1975-1981

Ranger District	Year	Host: Lodgepole pine	Whitebark pine	Western white pine	Ponderosa pine
Glacier View	1975	80			
	1976	1,213	192	5	
	1977	12,913		20	
	1978	48,494		25	
	1979	61,780	22,426	150	
	1980	85,160	93,525	420	
	1981	88,314	7,100		
Hungry Horse	1975	300		500	
	1976	5		150	
	1977			450	
	1978			350	
	1979	20		1,218	
	1980	21,567		600	
	1981	8,738		5,376	
Spotted Bear	1975			75	
	1976	30		20	
	1977	20			100
	1978	25			
	1979	20		50	
	1980	3,070		50	
	1981	1,300		900	
Swan Lake	1975			15	90
	1976				261
	1977	4			
	1978		150		25
	1979	25	2	150	1
	1980		310		30
	1981	450		3	2
Tally Lake	1975	5			70
	1976				
	1977				
	1978				
	1979	100		1	
	1980	12,840			
	1981	9,620			
Stillwater State Forest	1975				
	1976		195		
	1977	50	40		
	1978	400			738
	1979	643	489	250	
	1980	10,035			
	1981	1,000	100	1,270	
Private lands	1975				40
	1976	2,424			20
	1977	14,697			650
	1978	30,042	278		1,266
	1979	35,292	1,282		977
	1980	85,980	3,050		
	1981	65,637			300

Table 2.--Acres infested by host type, Kootenai National Forest, 1975-1981

Ranger District	Year	Host			
		Lodgepole pine	Whitebark pine	Western white pine	Ponderosa pine
Cabinet	1975			2,000	10
	1976				
	1977			1	
	1978				25
	1979				
	1980	250			100
	1981				
Fisher River	1975	270		15	130
	1976	860			
	1977	610			2
	1978	1,618			30
	1979	3,904			410
	1980	13,610			80
	1981	25,770			200
Fortine	1975				100
	1976				
	1977				
	1978	50			
	1979	360			150
	1980	1,160			
	1981	3,090	120		
Libby	1975	370		30	60
	1976	275	10		
	1977	450			1
	1978	589			
	1979	1,720			25
	1980	970			140
	1981	800			100
Rexford	1975	100		5	10
	1976	401			
	1977	576			2
	1978	1,167			
	1979	1,868			
	1980	3,350			
	1981	4,800			
State and private lands	1975				
	1976				
	1977				
	1978				
	1979	7,796			30
	1980	19,648			220
	1981	33,080			
Yaak	1975	5,110			660
	1976	18,894			
	1977	15,572			20
	1978	19,820			
	1979	32,951			
	1980	64,656			
	1981	74,315			

Table 3.--Acres infested by host type, Lolo National Forest and adjacent State land, 1975-1981

Ranger District	Year	Host			
		Lodgepole pine	Whitebark pine	Western white pine	Ponderosa pine
Plains	1975	2,405			30
	1976				
	1977	3,475			
	1978	6,915			
	1979	5,535			85
	1980	12,670			
	1981	9,430			
Thompson River	1975	2,600			100
	1976	17,174			75
	1977	7,124			60
	1978	17,646			75
	1979	3,174			
	1980	14,421			
	1981	6,765			60

Table 4.--Acres infested by host type, Glacier National Park, 1972-1981

Year	Host			
	Lodgepole pine	Whitebark pine	Western white pine	Ponderosa pine
1972	1,180			
1973	3,600			
1974	4,530			
1975	13,354			
1976	103,887			
1977	142,871		7	
1978	164,492		475	
1979	206,115	8,912	855	
1980	276,266	14,997	1,125	
1981	189,350	740	1,300	500

Table 5.--Tree mortality during 1979, 1980, and 1981, and trend prediction for 1982 for areas surveyed

Ranger District	Host	Trees killed/acre 1979	1980	1981	Predicted trend 1982
KOOTENAI NATIONAL FOREST[1/]					
Fisher River	LPP	39.0	12.4	39.0	Increasing
	PP	9.8	0	--	Endemic
Libby	LPP	28.4	8.3	--	Declining
Rexford	LPP	19.3	48.6	19.7	Static
Yaak	LPP	15.4	40.7	31.0	Increasing
Fortine	LPP	24.6	4.6	28.4	Increasing
LOLO NATIONAL FOREST[2/]					
Plains	LPP	17.0	2.4	11.2	Increasing
	PP	.6	0	2.4	Increasing
Superior	WP	3.6	6.8	19.6	Increasing
Thompson Falls	LPP	19.0	15.9	4.1	Static
	PP	14.3	0	--	Declining
	WP	3.6	6.8	19.6	Increasing
FLATHEAD NATIONAL FOREST[3/]					
Glacier View	LPP	87.3	12.3	2.1	Declining
	WBP	20.7	13.9	0	Declining
Swan Lake	LPP	13.5	30.9	38.4	Increasing
Hungry Horse	LPP	4.5	3.3	6.3	Increasing
	WWP	9.9	4.4	8.8	Increasing
Tally Lake	LPP	9.7	7.0	14.2	Increasing
Spotted Bear	WP	4.5	4.6	13.4	Increasing

1/ Averages based on data obtained from 115 variable-radius plots.
2/ Averages based on data obtained from 130 variable-radius plots.
3/ Averages based on data obtained from 305 variable-radius plots.

FLATHEAD NATIONAL FOREST

Infestation in lodgepole pine stands increased from 97,000 acres in 1979, to 122,000 acres in 1980, and to 175,000 acres in 1981. Within the Whitefish Range, mortality in whitebark pine type increased from 23,000 acres in 1979 to 93,000 acres in 1980. Although thousands of acres were infested in 1981, infestation could not be accurately mapped because many stands are intermixed with infested lodgepole pine. Approximately 7,500 acres of western white pine type were infested during 1981. Mortality in ponderosa pine type was mapped on 300 acres, mostly on private lands.

Glacier View Ranger District

Although acres infested increased from 85,160 in 1980 to 88,314 in 1981, the epidmic has declined significantly. Evaluation of 18 drainages showed newly attacked trees only in four areas. Of these four areas, an increase in the number of successfully attacked trees from 1980 to 1981 occurred only in Hay Creek. A marked decline occurred in stands at Frozen Lake, and in Teepee and Whale Creek drainages. Successfully attacked trees averaged 87.3/acre in 1979, 12.3/acre in 1980, and 2.1/acre in 1981. A significant increase was observed in lodgepole pine that were tallied pitchouts and strip attacks. Trees classed pitchouts averaged 27.5/acre, and those tallied strip attacks averaged 11.3/acre. The increase in these trees are indicative of a declining infestation. The majority of preferred large diameter lodgepole pine has been depleted from most stands. The younger, smaller diameter lodgepole pine possess thinner juvenile phloem which dries out faster, making these trees less susceptible to successful beetle attack. As smaller diameter trees are infested yearly as well as over the course of the outbreak, female beetles become smaller and produce fewer eggs, trees are more successful in repelling weaker beetles and the population declines.

Strip attacked trees are those attacked only on one or two sides. Usually these are smaller trees and possess thick phloem only on one or two sides where beetles make successful attacks. As the average diameter of remaining green trees declines yearly, secondary bark beetles (*Ips* spp., *Pityophthorus*, *Pityogenes*) which have been infesting the tops of trees, begin infesting the lower bole of smaller diameter trees. Because of thinner bark and phloem, these trees are more suitable to successful attack by these beetles and less preferred by mountain pine beetle. Smaller diameter trees infested by secondary beetles dry faster, and when infested by mountain pine beetle, the majority of the brood succumbs to dessication.

Localized tree mortality may continue in some drainages, but the overall infestation is predicted to continue to decline in 1982.

Hungry Horse Ranger District

Infested acreage declined from 21,567 in 1980, to 8,738 in 1981. Plot data (table 6) indicates an increasing trend in four of seven areas evaluated. Infested trees/acre average 6.3 in 1981, compared to 3.3 in 1980. Newly attacked trees were not found in plots established in Larch II and Skyland Creek drainages. However, if infestation continues in these areas, predicted tree mortality and volume loss can develop as shown in table 6.

Table 6.--Current and predicted tree mortality and volume loss for 8- to 10-year period, Hungry Horse Ranger District, 1980-1981.

Location	Trees killed per acre		Predicted mortality		Years for mortality to occur
	1980	1981	Trees/acre	Volume/ac (cu. ft.)	
Abbott Bay	5.5	7.6	153.5	2,855	10
Emery Bay	11.3	13.6	134.1	1,797	9-10
Emery Campgrnd.	2.7	20.5	57.8	1,147	6-7
Larch Creek I	0	2.4	165.5	2,495	10
Larch Creek II	1.4	0	104.6	1,561	10
Skyland Creek	0	0	336.9	3,121	10
Spotted Bear	1.9	0	168.9	2,955	10

Mortality in western white pine stands around Hungry Horse Reservoir increased from 600 acres in 1980, to 5,376 acres in 1981. Plot data are shown in table 7.

Table 7.--Mortality in western white pine stands, Hungry Horse Ranger District, 1979-1981.

Area	Trees killed/acre				Volume loss/acre (cu. ft.)			
	1979	1980	1981	Total	1979	1980	1981	Total
Clark Creek	45.2	4.6	4.1	53.9	732.4	105.6	213.7	1051.7
Devils Corkscrew	8.9	0.7	0	9.6	805.8	97.6	0	903.4
Heinrude Creek	33.1	21.9	18.5	73.5	377.1	293.5	250.9	921.5
Riverside Creek	32.3	17.3	7.8	57.4	613.0	205.7	188.7	1007.4
Wheeler Creek	4.5	4.6	13.4	22.5	48.0	119.5	238.8	406.3
Average	24.8	9.8	8.8	43.4	515.3	164.4	178.4	858.1

Although average number of trees killed/acre declined from 1979 to 1981, infested acres increased almost ninefold. We know the number of trees killed/acre is not evenly distributed, but based on acres infested, more than 47,000 white pine were killed during 1981. Mortality is expected to continue at about the same level in 1982.

Spotted Bear Ranger District

Infestation in lodgepole pine stands declined from 3,070 acres in 1980 to 1,300 acres in 1981. Plots established revealed no newly attacked trees. Mortality of mature white pine increased over 900 acres in 1981. White pine killed/acre increased from 4.5 in 1979, to 4.6 in 1980, and to 13.4 in 1981. Tree mortality and acres infested are predicted to increase, particularly in white pine; and even though no newly infested lodgepole pines were observed, infestation will probably increase in susceptible stands.

Swan Lake Ranger District

Lodgepole pine mortality was mapped over 450 acres in 1981, with no faders being mapped in 1980. Plot data showed infested trees averaged 53/acre in 1980 and 1981, in Idaho Creek drainage; and increased from 6.6/acre in 1980 to 23.3/acre in 1981 in stands at Rodgers Lake. If the infestation continues for 5 to 6 years, up to 161 trees/acre will be killed in susceptible stands in the Idaho Creek drainage and 94/acre in susceptible stands at Rodgers Lake. The outbreak is expected to continue and spread to adjacent areas in 1982.

Tally Lake Ranger District

Evaluations were conducted in 29 separate locations on the District. A summary of survey data are shown in table 8.

During 1978-1979, approximately 5,000 stands were examined to obtain data for hazard rating these areas for susceptibility to mountain pine beetle infestation. Calculations from stand data showed 30,700 acres of low hazard; 7,300 acres of moderate hazard; and 37,926 acres of high hazard. The system for hazard rating was based on that developed by Amman et al. (1977) and phloem thickness = (density + growth/tree). Besides stands rated on the above risk factors, those stands classed high hazard were close to adjacent developing and continuing epidemics which had increasing beetle populations, and where considerable tree mortality had persisted for several years. Adjacent areas also contained large contiguous high hazard areas with uninfested trees.

Tree mortality has increased steadily since 1978. Although area infested declined from 12,840 acres in 1980 to 9,620 acres in 1981, the number of trees killed increased from about 89,880 in 1980 to 136,604 in 1981. Although no 1981 attacked trees were tallied in 10 of the 29 areas evaluated, infestation will probably expand to these areas within 2 years.

Table 8.--Trees killed/acre 1979-1981, and mortality predicted for areas evaluated, Tally Lake Ranger District.

Area	Trees killed/acre				Predicted mortality		Years for mortality to occur
	1979	1980	1981	Total	Trees/ac	volume/ac cu.ft.	
Ashley Ck.	21.3	23.8	12.7	57.8	181.3	1,618	8
Bitterroot Lake #1	18.7	48.4	49.4	116.5	260.9	1,389	6
Bitterroot Lake #2	46.8	20.7	155.0	222.5	246.5	2,367	2-3
Boot Jack Lake	18.3	0	0	18.3	165.8	1,381	10
Dunsire Ck. #1	1.1	3.6	0	4.7	76.4	1,718	8-9
Fish Creek	6.2	2.1	53.2	61.5	90.1	1,593	4-5
Good Creek	11.8	0	0	11.8	49.4	636	6-8
Griffin Ck. #1	7.9	11.2	26.4	45.5	236.6	4,503	8
Griffin Ck. #2	17.4	6.0	30.9	54.3	185.4	3,487	5-6
Griffin Ck. #3	0	0	0	0	188.2	5,959	6
Griffin Ck. #4	0	4.2	0	4.2	237.2	5,430	10
Griffin Ck. #5	15.0	6.8	0	21.8	147.9	2,129	7-8
Hand Creek #1	0	0	0	0	103.4	2,184	10
Hand Creek #2	0	0	0	0	142.4	3,071	10
Herring Creek	3.9	2.2	18.1	24.2	152.2	2,900	10
Hill Meadow	35.2	6.8	15.1	57.1	107.7	806	7-8
Ingallo Creek	1.8	1.9	2.4	6.1	81.8	2,827	8-9
Logan Creek #1	17.7	4.8	4.4	26.9	67.5	1,055	7-8
Logan Creek #2	0	0	2.7	2.7	49.8	1,046	10
Lone Lake	0	0	14.1	14.1	168.0	940	10
Marian	0	11.5	6.3	17.8	21.4	237	3
Martin Lake Rd.	32.3	7.7	0	40.0	72.0	619	5-6
Pleasant Valley Mountain	9.5	30.1	9.5	49.1	285.5	3,602	7
Round Meadows	0	0	0	0	195.7	1,995	10
Squaw Meadows Ck.	5.0	10.0	13.0	28.0	177.8	3,884	8-9
Squaw Meadows	2.0	0	0	2.0	70.0	2,731	6
Swanson Creek	9.9	0	0	9.9	211.8	3,918	10
Sylvia Lake	0	0	0	0	107.0	2,369	10
Dunsire Ck. #2	0	0	0	0	97.7	1,466	10
Average	9.7	7.0	14.2	30.9	144.0	2,340	

As shown in table 8, considerable variation occurs between stands in the number of years for the susceptible trees to be killed. The variation is dependent on a combination of several factors:

1. Average age and diameter of lodgepole pine $\geq$ 5 inches d.b.h. in susceptible stands.

2. Percent of lodgepole pine in the stand. Is lodgepole pine the dominant species?

3. Proximity of major outbreaks to uninfested stands and their proximity to stands where epidemic infestation has occurred for 3 to 4 years.

4. Relationship of elevation and latitude.

5. Are beetle populations increasing within infested stands and also migrating in from adjacent outbreaks?

Those stands classified as high hazard met the criteria outlined in the Flathead EA for mountain pine beetle, 1979. In addition, these stands are also close to adjacent epidemic infestation on the Kootenai and Lolo NF's as well as those on the Flathead; elevation and latitude are not factors limiting a population expansion of the beetle; and beetle populations are building in place as well as a probable migration of beetles from adjacent infestations to stands on the Tally Lake District.

Infestations expanded and intensified on the adjacent Kootenai NF in 1981. Data from areas evaluated are shown in table 9. The average number of trees killed/acre increased almost threefold from 1980 to 1981 on the Forest.

Table 9.--Trees killed/acre by mountain pine beetle, Fisher River Ranger District, 1979-1981.

Location	Trees killed/acre			Total
	1979	1980	1981	
Brush Ck.	16.0	15.2	1.7	32.9
Coniff Ck.	0	31.0	42.5	73.5
Dahl Lake	23.9	8.5	14.3	46.7
Island Lake	14.0	20.2	29.9	64.1
McGregor Campground	78.6	11.6	115.7	205.9
McGregor Lake	164.2	12.8	14.2	191.2
McGregor Pass	33.0	6.6	105.9	145.5
Pleasant Valley	48.4	3.9	30.6	82.9
Pleasant Valley Ck.	31.7	13.0	40.2	84.9
S. Portal	43.7	10.8	19.8	74.3
Wall Ck.	11.9	2.4	14.6	28.9
Average	42.3	12.4	39.0	93.7

Data shows a decline in number of trees killed/acre from 1979 to 1980; however, trees killed in 1979 or before are tallied together. Beetle populations and resultant tree mortality are extremely high in several areas, particularly around McGregor Lake. As the larger component of trees are depleted from stands on the adjacent Fisher River Ranger District, Kootenai NF and Thompson River drainage of the Lolo National Forest, beetles will migrate to adjacent stands. This could continue for several more years, resulting in more rapid reduction of susceptible type, particularly on the Tally Lake District.

Recent stand exam data were acquired from Districts on five forests sustaining epidemic mountain pine beetle infestation. Data were run through FPM INDIDS program and Cole's Mountain Pine Beetle Model, then further subjected to Analysis of Variance, then graphed to show lodgepole pine mortality/habitat type over time. Analysis showed the percent of lodgepole pine killed and volume loss varies with habitat type group. In some habitat types, tree mortality increases rapidly and all susceptible trees will be killed in a relatively short time period. In others mortality may occur over a 10-year period and never exceed 30 percent of the stand. All susceptible trees may be killed in other habitat types but it may require 8 to 10 years.

Figures 2-8 show how tree mortality varies by habitat type. These were grouped by productivity class as listed in the Flathead Forest Standards and Guidelines for Habitat Type Groups dated June 1980.

These data may provide some guidance as to which stands within those classed high hazard should receive priority management. Where data indicates stand mortality may not exceed 20-30 percent even over a 10-year period, management may be postponed until the next decade. This would allow management for those stands with habitat types indicating considerable tree mortality over a short time period.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP II
(moderately warm and dry) FLATHEAD NATIONAL FOREST

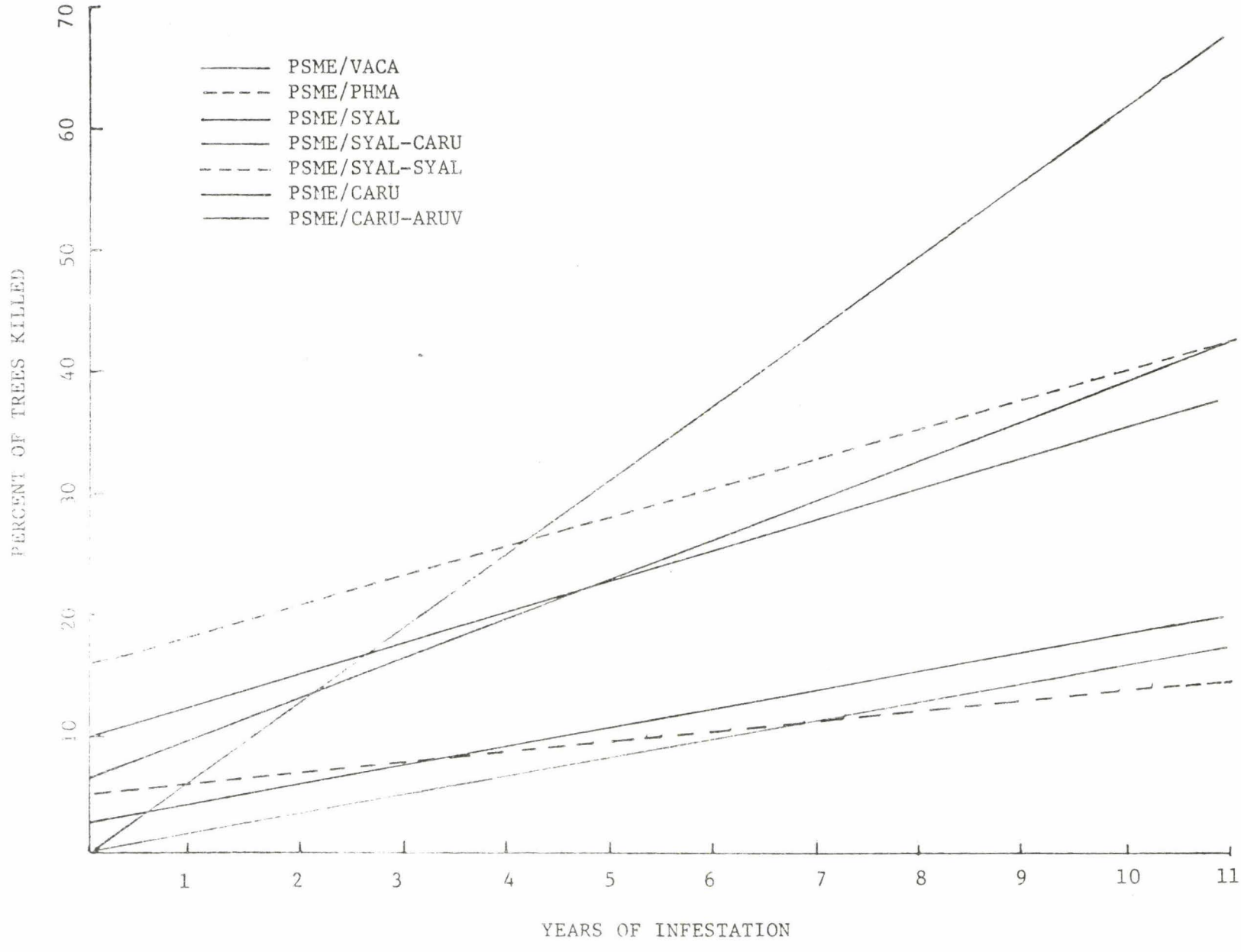

Figure 2.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP III
(moderately cool and dry) FLATHEAD NATIONAL FOREST

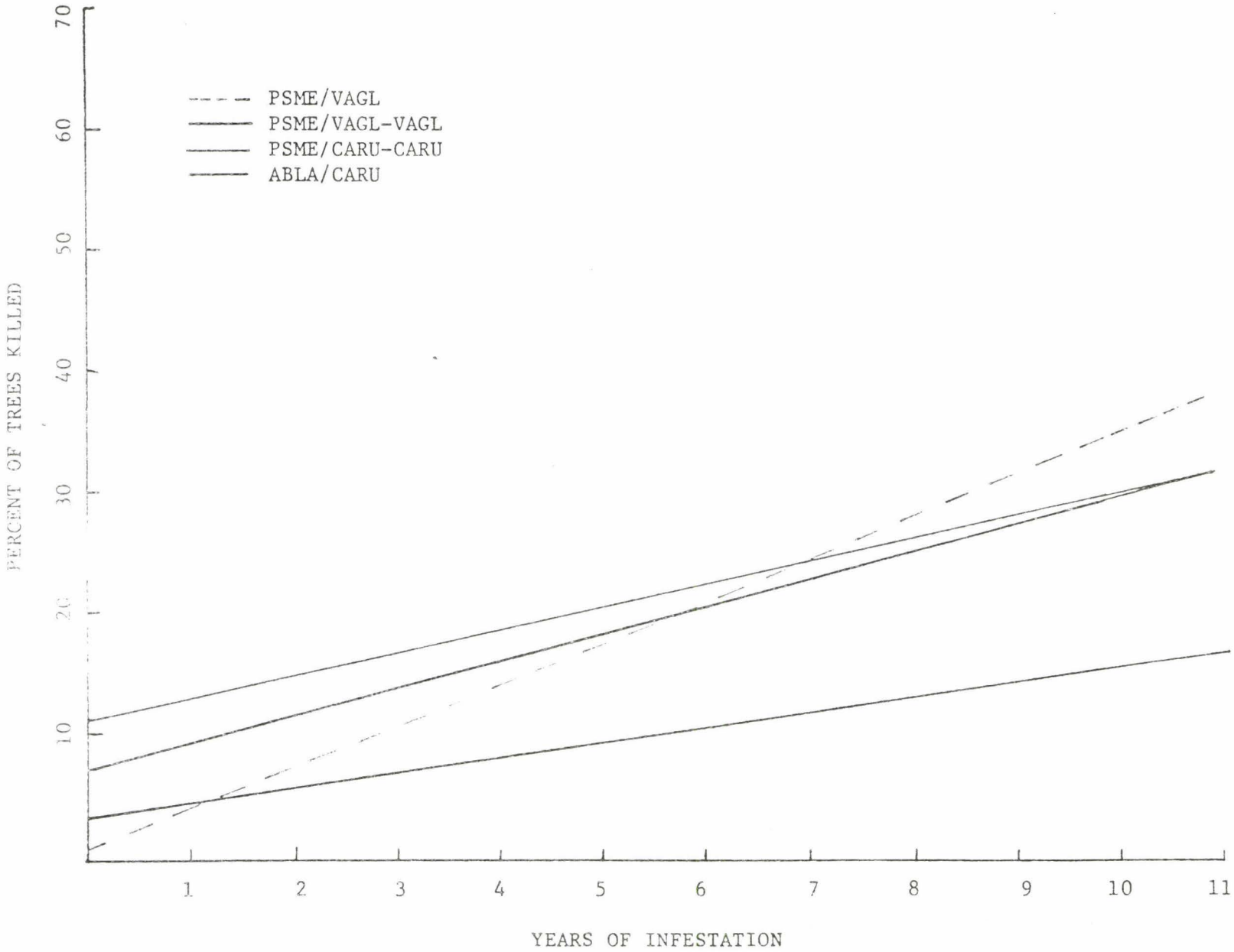

Figure 3.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP IV
(cool and moderately dry) FLATHEAD NATIONAL FOREST

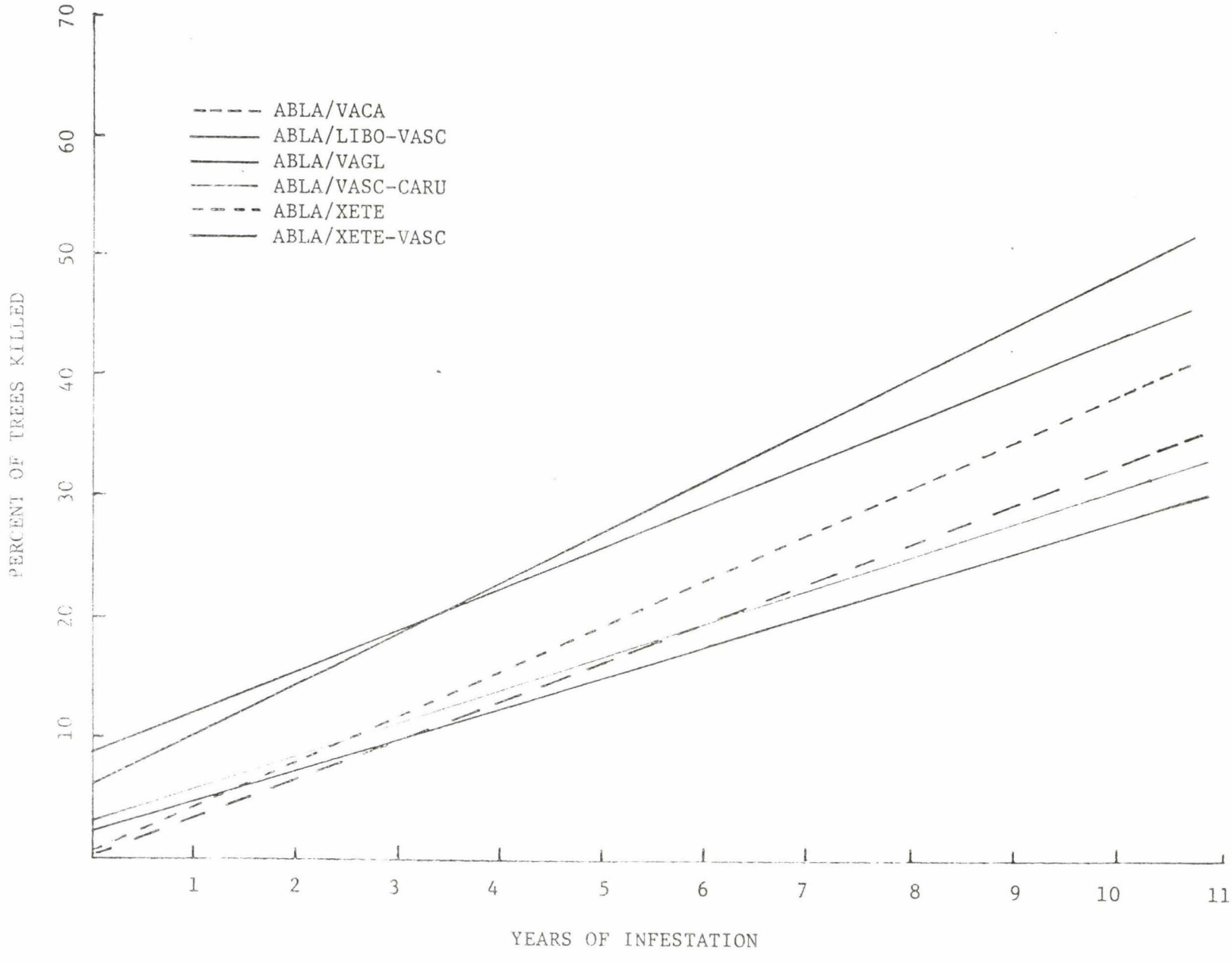

Figure 4.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP V
(moderately cool and moist) FLATHEAD NATIONAL FOREST

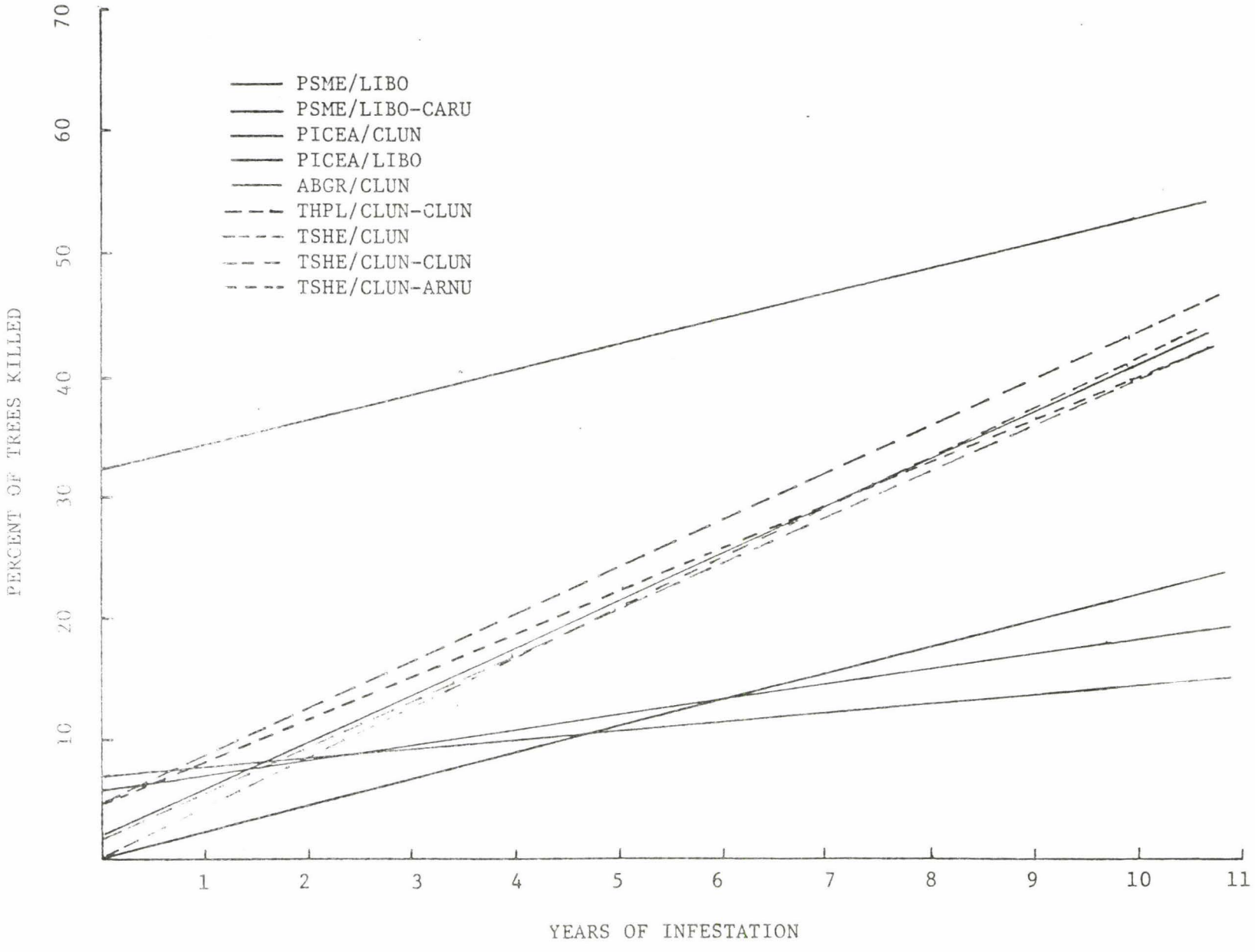

Figure 5.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP VI
(cool and moist) FLATHEAD NATIONAL FOREST

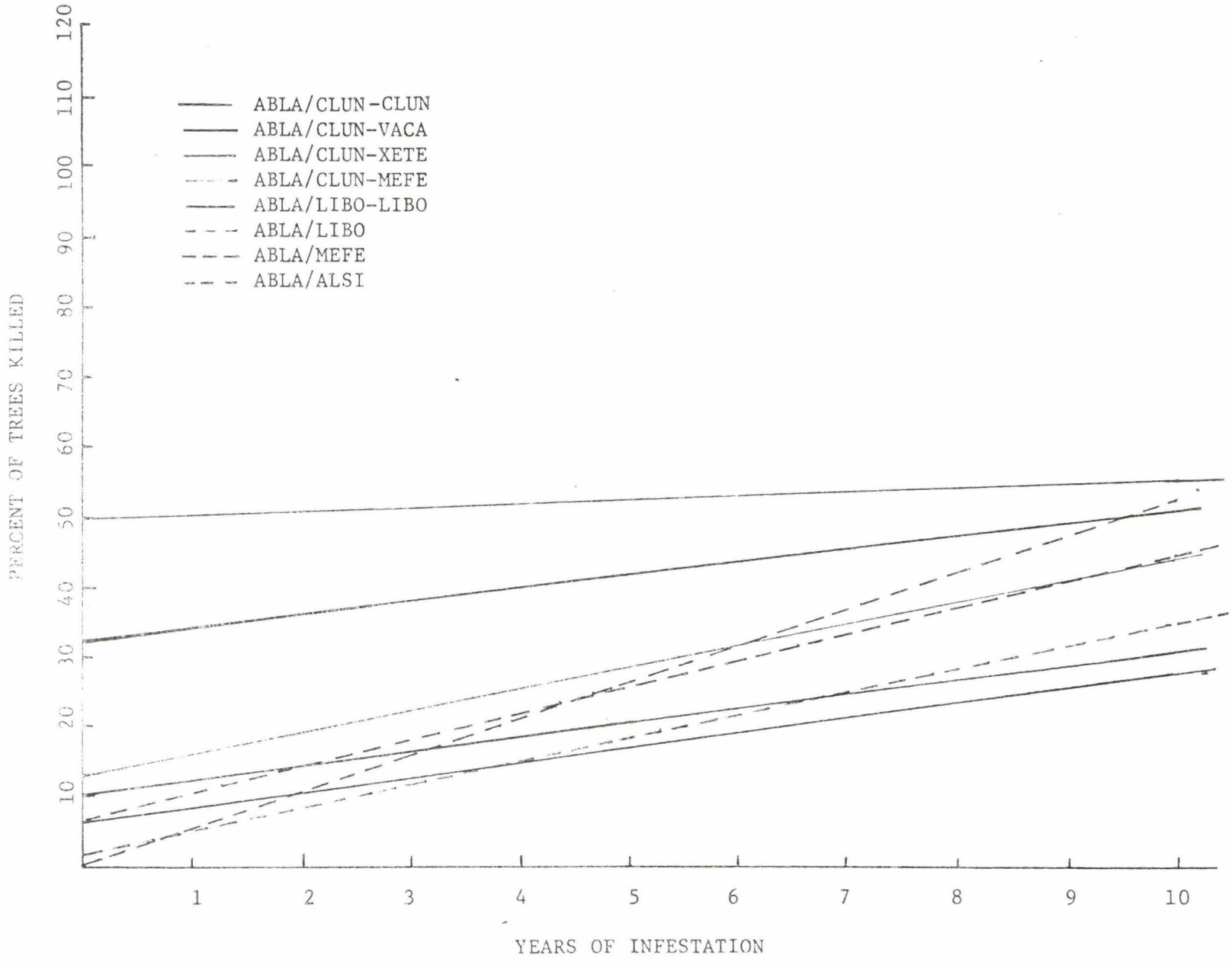

Figure 6.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP VII
(wet) FLATHEAD NATIONAL FOREST

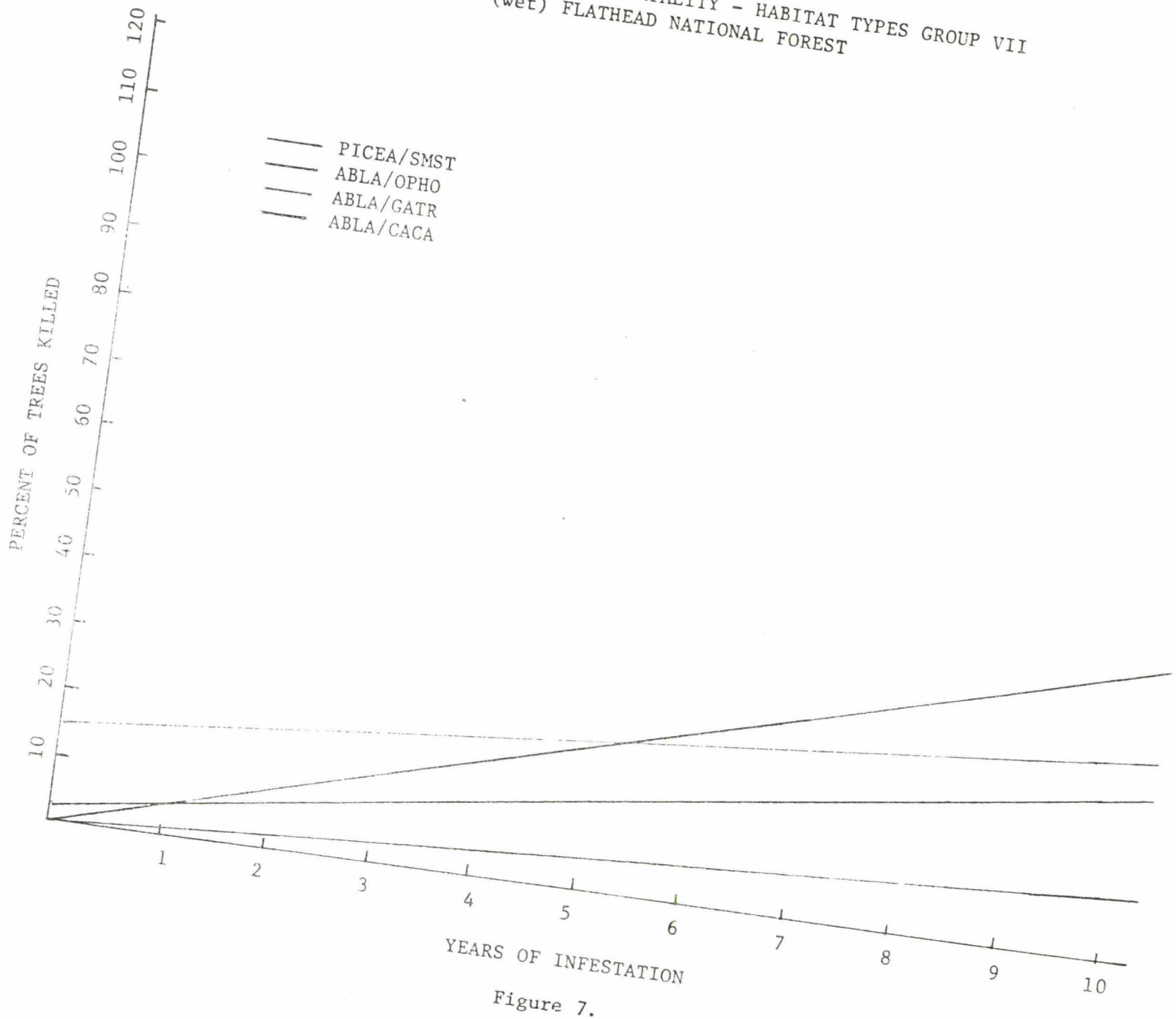

Figure 7.

PREDICTED LODGEPOLE PINE MORTALITY - HABITAT TYPES GROUP VIII
(cold and moderately dry) FLATHEAD NATIONAL FOREST

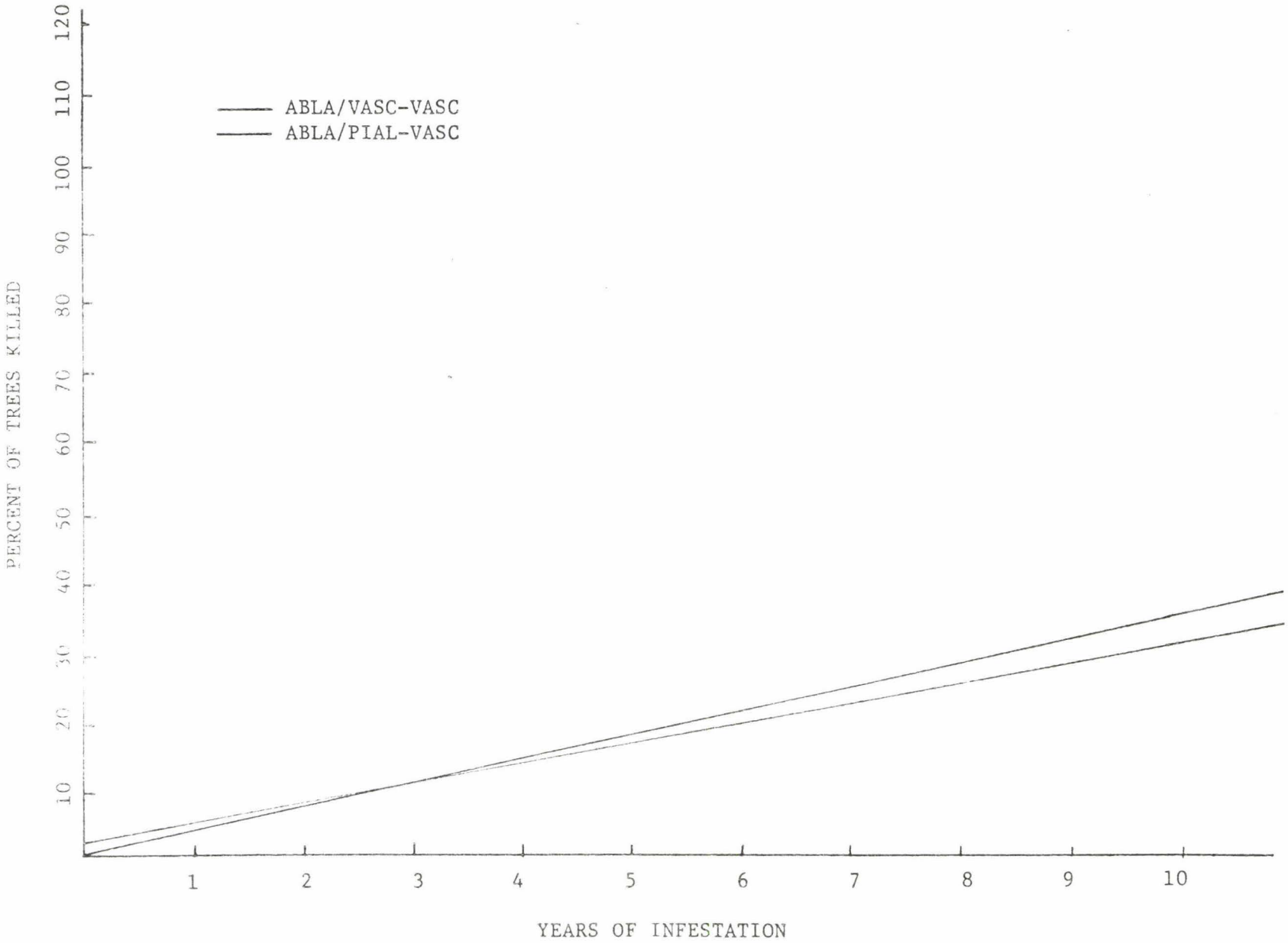

Figure 8.